Getting to Know: Volume and Pitch

Do you know what a cello sounds like? The low, rich sound of a cello is produced when the musician pulls a bow across the instrument's metal strings. As the bow moves across a string, friction between the bow and the string causes the string to vibrate. These vibrations are passed along to molecules of air near the strings. Those molecules, in turn, cause vibrations in the air molecules next to them, and so the sound energy produced by the vibrating string is carried all the way to your ear.

The vibrations that carry the sound energy are sound waves. As the sound waves enter your ear, tiny bones in your inner ear—the malleus, incus, and stapes—also begin to vibrate. These vibrations are carried to fluid inside the cochlea and then are translated into signals that your brain can interpret as sound.

Now, think about what a flute sounds like. You probably know that a flute can produce a very high-pitched sound. The sound is produced when the musician blows air across an opening in the instrument. Sound waves that begin as vibrations in the column of air inside the instrument quickly carry sound through the air to your ear.

Both the music a cello makes and the music produced by the flute are examples of sound energy.

The low-frequency sound waves produced by this cello have a low, rich sound.

The high-frequency sound waves made by a flute produce high-pitched sounds.

What makes sounds different?

The difference between the sounds a flute makes and the sounds a cello makes are caused by differences in the sound waves each instrument produces.

Sound waves are a type of compression, or longitudinal, wave. All waves have certain properties such as wavelength and frequency. The *wavelength* of a sound wave is the distance between the compressions, while its *frequency* is the rate at which the compressions pass a given point.

The frequency of a sound wave is related to the pitch of the sound. A sound wave with a high frequency, like a flute's sound, has a higher pitch. These high-frequency sound waves also have shorter wavelengths. In contrast, the sound waves a cello produces have lower frequencies and longer wavelengths. As a result, the sound has a lower pitch.

Misconception 1: ***When a sound goes up in pitch, it gets louder.***

Volume, which is the amount of energy in a sound wave, refers to the loudness of a sound, while pitch is determined by the frequency of the sound wave. A sound can get louder and softer, while the pitch remains the same. Similarly, a sound can become higher in pitch but not increase in volume or lower in pitch but not decrease in volume.

Do differences in sound waves explain why sounds are louder and softer, too?

The harder this drummer strikes the drum, the greater the amplitude of the sound wave, and the greater the volume of the sound. However, the pitch of the sounds does not change.

Yes, waves that carry more energy are louder than those that carry less energy. If a drummer hits a drum with a greater amount of force, the sound waves that are produced will carry more energy. The high-energy sounds that are produced will be louder to our ears. If the drummer taps the drum lightly, the sound waves produced will have much less energy, and the sound will be softer.

The property of a sound wave that refers to the energy a wave carries is called *amplitude*. As the amplitude of a sound wave increases, the volume of the sound increases. *Volume* is the term that refers to how loud or soft a sound is. When you turn up the volume control on your television, what you are doing is increasing the amplitude of the sound waves coming out of the speaker.

As you learn more about sound waves, pay attention to examples in your daily life that illustrate different types of sound. Think about how the frequency, wavelength, and amplitude of the sound waves you hear relate to differences you hear in the sounds.

Misconception 2: ***Hitting an object harder changes the pitch of the sound produced. For example, if I hit a drum harder, the pitch of the sounds it produces will change.***

Hitting an object harder increases the amount of energy produced. This increases the volume of the sound, but it does not cause the pitch to become higher.

You've probably turned up the volume of your .mp3 player, cell phone, television, or stereo. What this does is increase the amount of energy the sound wave is carrying, but the pitch of the sounds is unchanged.